

Back Bay: Report on Salinity
and Water Clarity in 1986

by

Mitchell D. Norman
Supervising Fisheries Biologist

and

Ron Southwick
Assistant Fisheries Biologist

Virginia Commission of Game and Inland Fisheries

April, 1987

Back Bay: Report on Salinity and Water Clarity in 1986

by

Mitchell D. Norman and Ron Southwick

Abstract

Salinity, turbidity and various other water quality parameters were monitored monthly in 1986 at 24 stations on Back Bay. Results show Back Bay to be brackish (mean salinity 10.1‰ SS) and very turbid (mean Secchi disc visibility 7.3 inches and mean turbidity 25.1 NTU). Water clarity was the poorest since records are available (1959). The mean salinity for 1986 was the third highest since 1962 (year of the "Ash Wednesday" storm). The salinity level was relatively uniform between stations in 1986, a condition which contrasts markedly with past years and is attributed to the absence of saltwater pumped into the bay in 1986. The saltwater pump at Little Island was shut down in June, 1985 when the City of Virginia Beach initiated a variable pumping schedule as recommended by a consultant firm. Under this variable pumping schedule, the volume of saltwater pumped in a given month is calculated from an equation incorporating rainfall, evaporation and watershed losses. Due to the slow flushing rate for Back Bay (which was accentuated by a drought in 1986) and the influx of saltwater from the Pamlico-Albermarle-Currituck Sound complex, the salinity in Back Bay remained relatively high throughout 1986 in spite of the pump shutdown. Without the introduction of saltwater by the Little Island pump, wind action dispersed the saltwater to almost uniform proportion all over the bay. In previous years when saltwater was pumped regularly into Back Bay, There was significant variation in salinity

between stations.

Procedures

Selected water quality parameters on Back Bay were monitored monthly in 1986 at 24 stations (Figure 1). This was an increase of two sampling stations over previous years. The additional stations were added to give a more complete distribution of sampling stations over the bay.

Monitored parameters included temperature ($^{\circ}\text{C}$), specific conductance (micromhos/cm), salinity (ppt), turbidity (NTU), Secchi disc visibility (inches), and pH. Temperature, conductivity and salinity were determined with a YSI Model 33 S-C-T Meter. Turbidity was measured with a Hach Model 2100-A Turbidimeter. A LaMotte Model-HA Meter was used to measure pH. Salinity (ppt) was converted to percent sea strength (% SS) based on 35 ppt salinity as an average for the North Atlantic Ocean. Since the general public is more familiar with salinity as % SS, that unit of measurement is used in this text.

The samples were usually collected between the tenth and twentieth of each month for standardization. All samples were collected from the upper 1 ft of the water column. The individual station results and monthly means are presented in Table 1.

The salinity, turbidity and pH data for 1986 were sent to the Southeastern Cooperative Wildlife and Fisheries Statistics Unit at North Carolina State University for statistical analyses. The Unit's analyses on these data sets included 1) analysis of variance (ANOVA) to determine the significance of differences among months and stations, and 2) Duncan's

multiple range test on the monthly and station means to determine seasonal trends. The Statistical Unit also compared the salinity data for the period July, 1985 - December, 1986 (without saltwater pumping) with the period January, 1982 - June, 1985 (with saltwater pumping) to analyze for differences in variability between the two data sets. This analysis included 1) t-test using natural logarithm transformations of the monthly standard deviations and 2) a Wilcoxon Rank Sum non-parametric test. Both tests were performed to compare the difference between the mean of months (34) with pumping and the mean of months (17) without pumping.

Results and Discussion

Mean water temperature ranged from 3.6°C in January to 28.0°C in August. During this period the mean water temperature increased progressively each month except for small declines in March and May. The greatest change in water temperature occurred from May to June (10.5°C). The water was relatively warm ($>16.0^{\circ}\text{C}$) from April through November.

The pH of the water was generally 7.4 to 7.8, which is slightly alkaline and expected for a water such as Back Bay. ANOVA for pH showed significant differences between stations. The pH in the southern part of the bay (stations 17-22) was significantly lower than in the northern part. Duncan's multiple range test on the monthly means for pH did not show any seasonal trends.

Mean conductivity ranged from 3250 micromhs/cm in January to 7373 microhms/cm in August. As expected, conductivity was closely correlated with salinity ($R = .9274$, d.f. = 11).

Mean salinity per month in 1986 ranged from 7.9% SS in March to 12.3% SS in November (Figure 2). The average for the entire year was 10.1 % SS, which is the third highest annual mean salinity since 1962, year of the "Ash Wednesday" storm (Figure 3). The years with higher mean salinity were 1980 and 1981. Since annual means on any parameter can sometimes be misleading due to the extended time period, the mean salinity was graphed on a monthly basis for the entire data set (1965 - 1986). That graph is enclosed in the appendix. From this monthly mean salinity graph, three distinct periods of varying salinity can be observed :1) from 1965 through mid-1974, the salinity was generally less than 10 % SS, 2) from mid-1974 through late-1978, the salinity was generally less than 3 % SS, and 3) from 1979 through 1986, the salinity was generally greater than 10 % SS.

ANOVA on the 1986 salinity data showed a significant difference between stations, with the salinity higher at stations most distant from the pump outfall, e.g. stations 17-22 (letter John Finnegan (NCSU), 1/30/87). This observation is the reverse of previous years which show a significantly higher salinity in the northern area of the bay, e.g. near the site of the pump outfall. Of course, the higher salinity in the southern part of the bay in 1986 reflects a natural scheme without the influence of the pump operation. The salinity in the South was higher due to mixing with the more saline water of Currituck Sound.

Duncan's multiple range test on the monthly salinity means suggested a trend during the course of the year. This trend was for a gradual increase in salinity as the year progressed, which can be readily observed

in Figure 2. This phenomenon can be attributed in part to the drought condition in 1986. Without fresh water input to counteract evaporation losses, the bay gradually became more brackish. Of course, this was compounded by more saline water blown in from Currituck Sound with the prevailing south-southwest summer wind. A second factor also contributed to the higher salinity in Back Bay during the latter half of 1986. The same S-C-T Meter was used for all readings January through June. Another S-C-T Meter, which gave slightly higher salinity readings, was used July through December. It is believed that the change in meters was primarily responsible for the higher salinity readings during the last half of the year relative to the first half, but this meter change does not explain the progressive increase in salinity July through December. Rather the progressive increases during that period represent actual occurrences.

Although ANOVA tests by NCSU showed that salinity was "heterogeneous over the bay and during the year" in 1986, the variability was small compared with periods when the saltwater pump was operating. This finding is of special interest in relation to a recommendation by the City's consultant firm (Roy Mann & Assoc., Inc., "A Management Plan for the Back Bay Watershed", 1984). The recommendation was that the saltwater pump discharge line should be extended 6000 ft out into North Bay for a "more uniform dispersal of saltwater". The reduced variability between stations in the 1986 salinity data shows quite clearly that a relatively uniform dispersal of saltwater can be achieved without a pipeline extension. To explore this concept further, VCGIF requested the Statistics Unit at NCSU to compare variability in the salinity data between periods with and without saltwater pumping. Since the City discontinued pumping in June,

1985, the period July, 1985 - December, 1986 was the logical choice for the "no pumping" period since it was current and included an almost complete data set (17 months). The period January, 1984 - June, 1985 was selected as the "with pumping" period since it 1) was contiguous in time with the "no pumping" period, 2) was of equal duration (18 months), 3) included an almost complete data set (15 months), and 4) represented a period of almost continuous pumping (except for November and December, 1984 when the pump was shut down for maintenance). To limit any possible bias which might be caused by including a two-month "shut-down" in a 18 month "with pumping" period, that period was extended back to January, 1982 and a separate analysis performed. Expansion of the "with pumping" period to 42 months should reduce the variability in salinity which might be caused by maintenance pump shutdown. Comparing both "with pumping" periods independently with the "no pumping" period, the Statistics Unit at NCSU reached the following conclusions (letter David W. Turner (NCSU), 3/18/87):

- 1) "The average variability among stations while pumping occurred is about 4 times greater than the same average calculated for the months after pumping stopped. The t-test indicates a statistically significant difference at the .001 significance level."
- 2) "Without data supporting some other explanation it would appear that pumping increases variability in percent salinity among stations which are distributed rather broadly over the bay,..."
- 3) "It seems almost obvious from the standard deviations, measures of variability, that the salinity among stations is relatively

uniform for months without pumping compared to the variation among station salinity for months when pumping occurred."

- 4) "Average station percent salinity in months when no pumping occurs appears about as high as the average in the presence of pumping but the station values deviate relatively little from their average, suggesting a much more uniform salinity distribution under natural or unperturbed flow patterns."

In other words and in special relation to the proposed extension of the saltwater pipeline, a relatively uniform salinity regime in Back Bay can be achieved simply by not pumping saltwater continuously into the system. Also, the average salinity for the entire bay can be maintained as high without continuous pumping as with it. What this boils down to is: If it is desirable to pump saltwater into Back Bay and maintain a relatively uniform salinity level over the bay, the proposed pipeline extension is not necessary. All the City of Virginia Beach has to do is pump sufficient saltwater into the bay to reach the "desired" average salinity level. Then discontinue pumping until the salinity drops below the desired level. Within a few months of pump shutdown, the wind action will disperse the saltwater to an almost uniform salinity level throughout the entire bay, thereby achieving the objective of the proposed pipeline extension. Considering the slow flushing rate for the bay, the salinity should remain at or near the "desired" level for at least a year (even with normal rainfall). This is well demonstrated by the data collected July, 1985 through December, 1986. When the pump was shut down in June, 1985, the average salinity in the bay was 12.3 % SS.

After 18 months without pumping, the salinity in December, 1986 averaged 11.6 % SS (a decline of only 0.7 % SS). During this 18 month interim, the salinity dropped below 10.0 % SS on 7 monthly readings; the lowest of these was 7.9 % SS (March, 1986).

As evidenced by low Secchi disc visibilities and high turbidity readings, water clarity in Back Bay was very poor in 1986. Only one month had water clarity results that could be considered as "approaching satisfactory". That month was July when the mean Secchi disc visibility was 14.0 inches (Figure 4) and mean turbidity was 12.3 NTU (Figure 5). For all other months, the mean Secchi disc visibility was below 9.0 inches. Months with the poorest water clarity readings were January, March, October and November when Secchi disc visibility was generally less than 5.0 inches. More turbid water is expected during the Winter and Spring months when the wind action is generally greater and aquatic vegetation less abundant. The yearly averages for Secchi disc visibility and turbidity were 7.3 inches and 25.1 NTU, respectively. As expected, turbidity was inversely and significantly correlated with Secchi disc visibility ($R=.7279$, d.f. = 11).

Figure 6 shows the mean annual Secchi disc visibility from 1959 through 1986. The monthly means for this period are graphed in a fold-out appendix. As is clearly illustrated in these graphs, Back Bay water clarity in 1986 was the worst since records are available (a period spanning 27 years). Back Bay is more turbid today than it was in the late 1950's - early 1960's when there was so much public concern about the "muddy water" condition in the bay. During those "early" years,

Secchi disc visibility readings of 30 - 35 inches were obtained. During the years of maximum vegetation growth (1973-1975), Secchi disc readings routinely averaged more than 30 inches and individual station readings frequently exceeded 60 inches. As discussed earlier, Secchi disc visibility in 1986 was generally less than 9 inches, an appalling decline in water clarity from years past. That decline is unquestionably correlated with the decline in aquatic vegetation. Water clarity in Back Bay was at its best during the mid-1970's. That period was also a time of abundant aquatic vegetation (Figure 7). For most of the 1970's vegetation covered at least 70% of the bay, and the mean Secchi disc visibility per month was generally at least 25 inches. Since 1980 the abundance of aquatic vegetation has dropped precipitously and the water clarity has followed suit. For those who insist that increased salinity improves water clarity and aquatic vegetation, it should be noted that the salinity in Back Bay has been higher since 1980 than since the "Ash Wednesday" storm of 1962. Yet water clarity and vegetation have been at record lows for several years (decline started essentially in 1980, first year of "high" salinity in almost a decade). It should also be pointed out that the salinity in Back Bay was considerably lower in the mid-1970's (period of excellent freshwater fishing as well as abundant vegetation and good water clarity). With all of these years of data to disspell the contention of some that saltwater pumping has been the "saviour" of Back Bay, the validity of the pumping program seems very questionable.

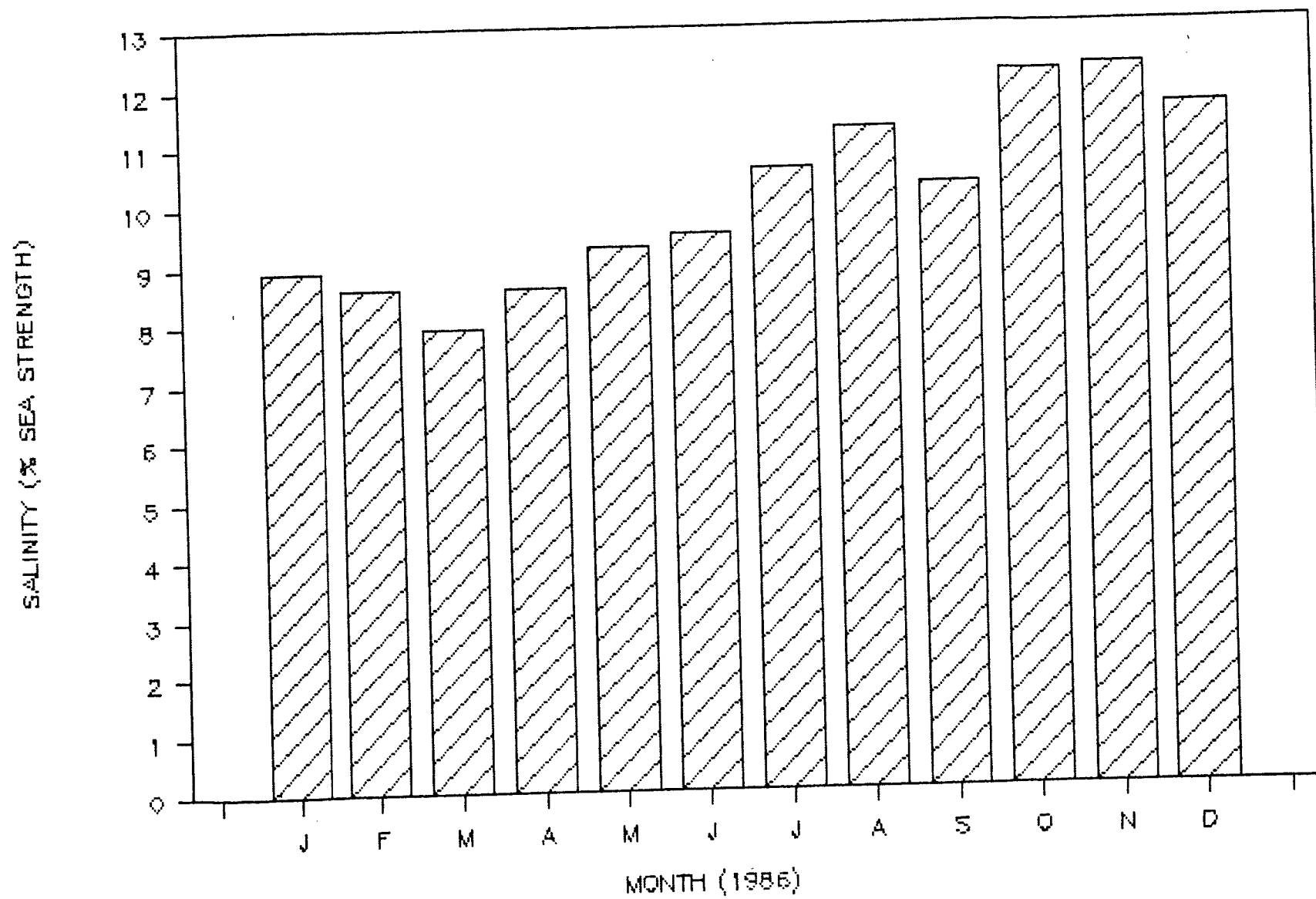


Figure 2. Mean salinity/month in 1986, Back Bay.

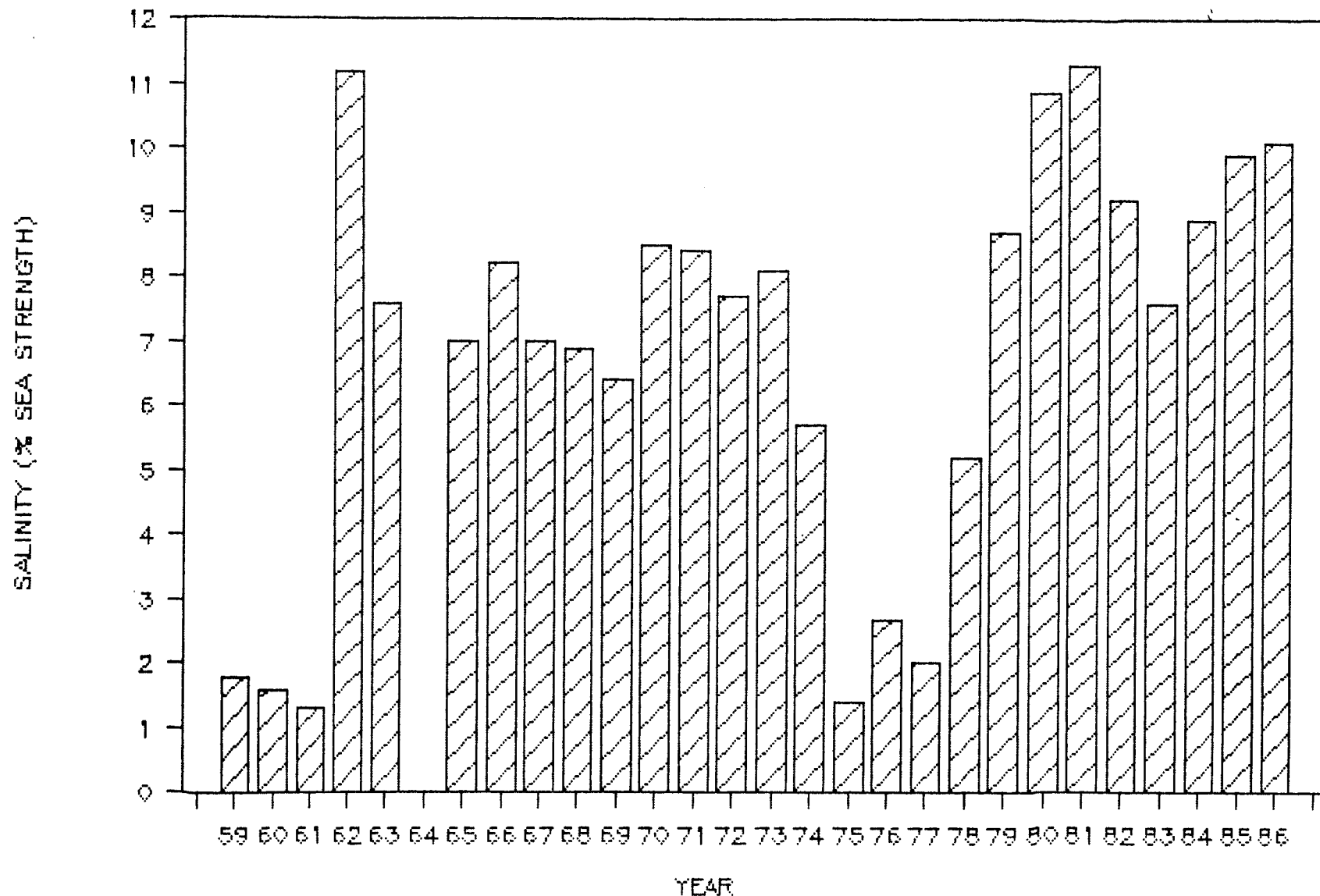


Figure 3. Mean salinity/year (1959-1986) in Back Bay. Salinity readings from 1959 through 1963 collected at 8 stations (centers of 8 vegetation transects); samples taken 7/59, 12/59, 4/60, 6/60, 10/60, 2/61, 4/62, 7/62, 10/62 and 1/63. Salinity readings from 1965 through 1986 generally collected monthly at 22 stations.

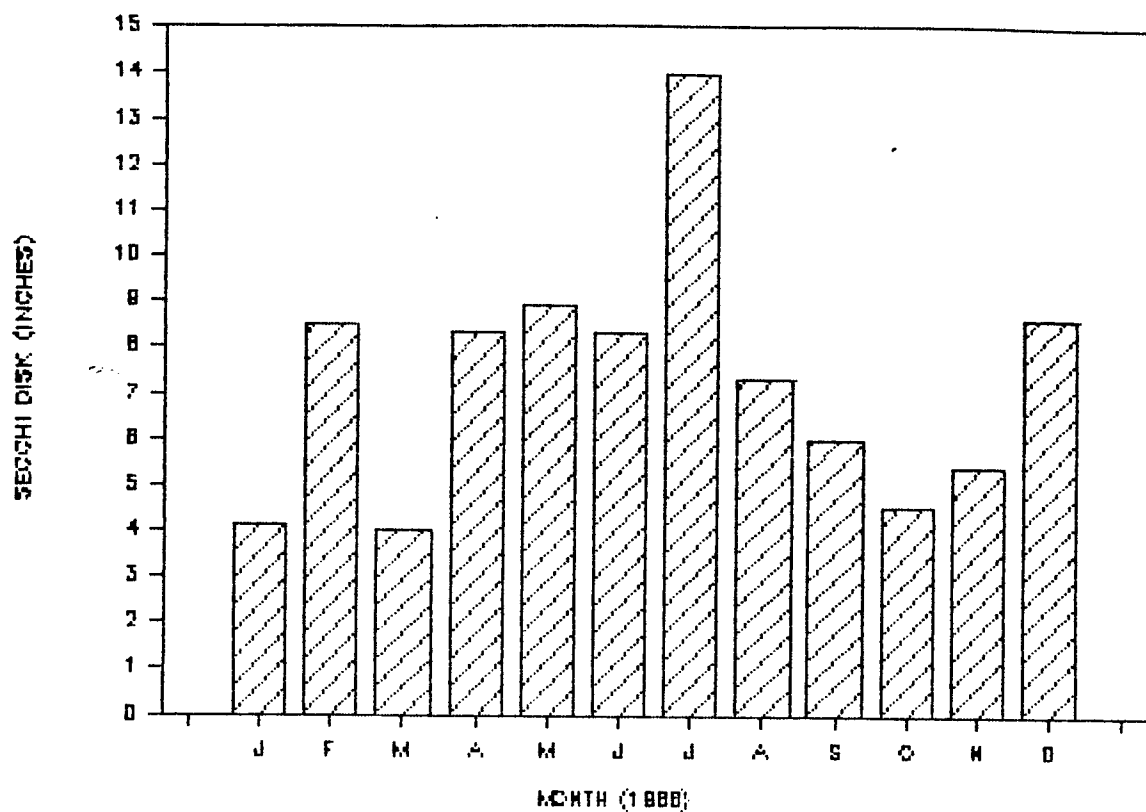


Figure 4. Mean Secchi disc visibility/month in 1986, Back Bay.

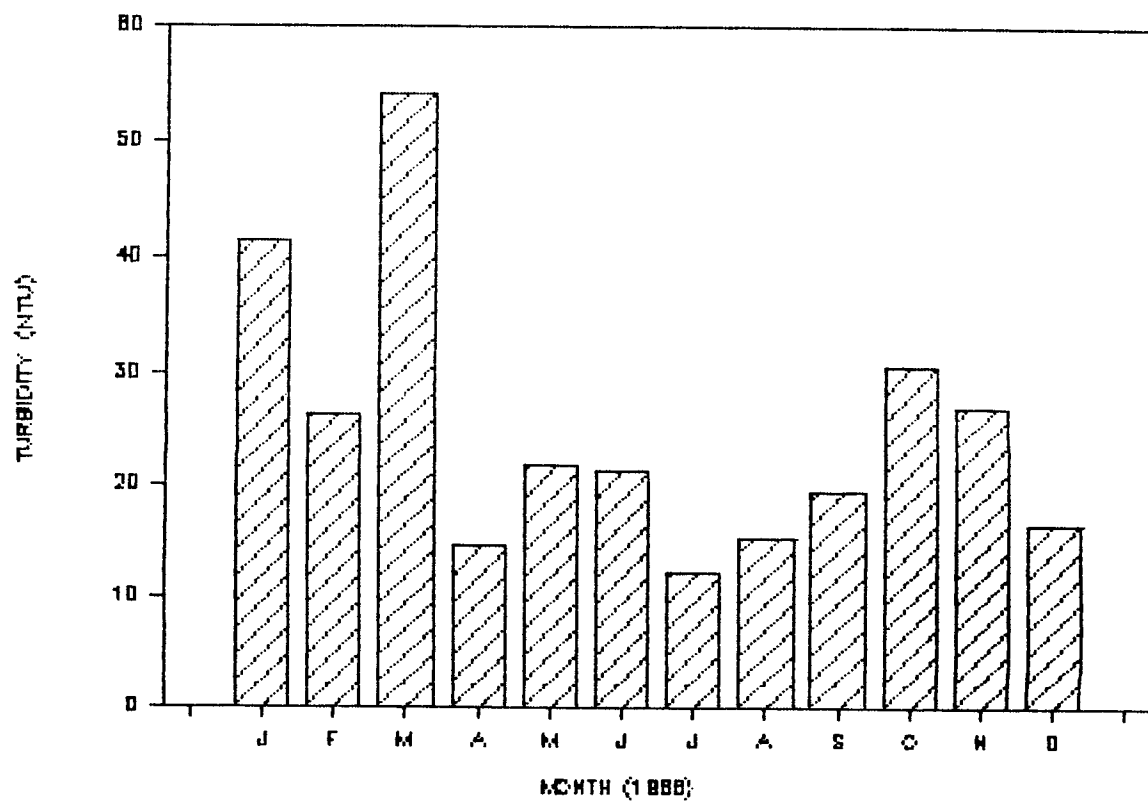


Figure 5. Mean turbidity (NTU)/month in 1986, Back Bay.

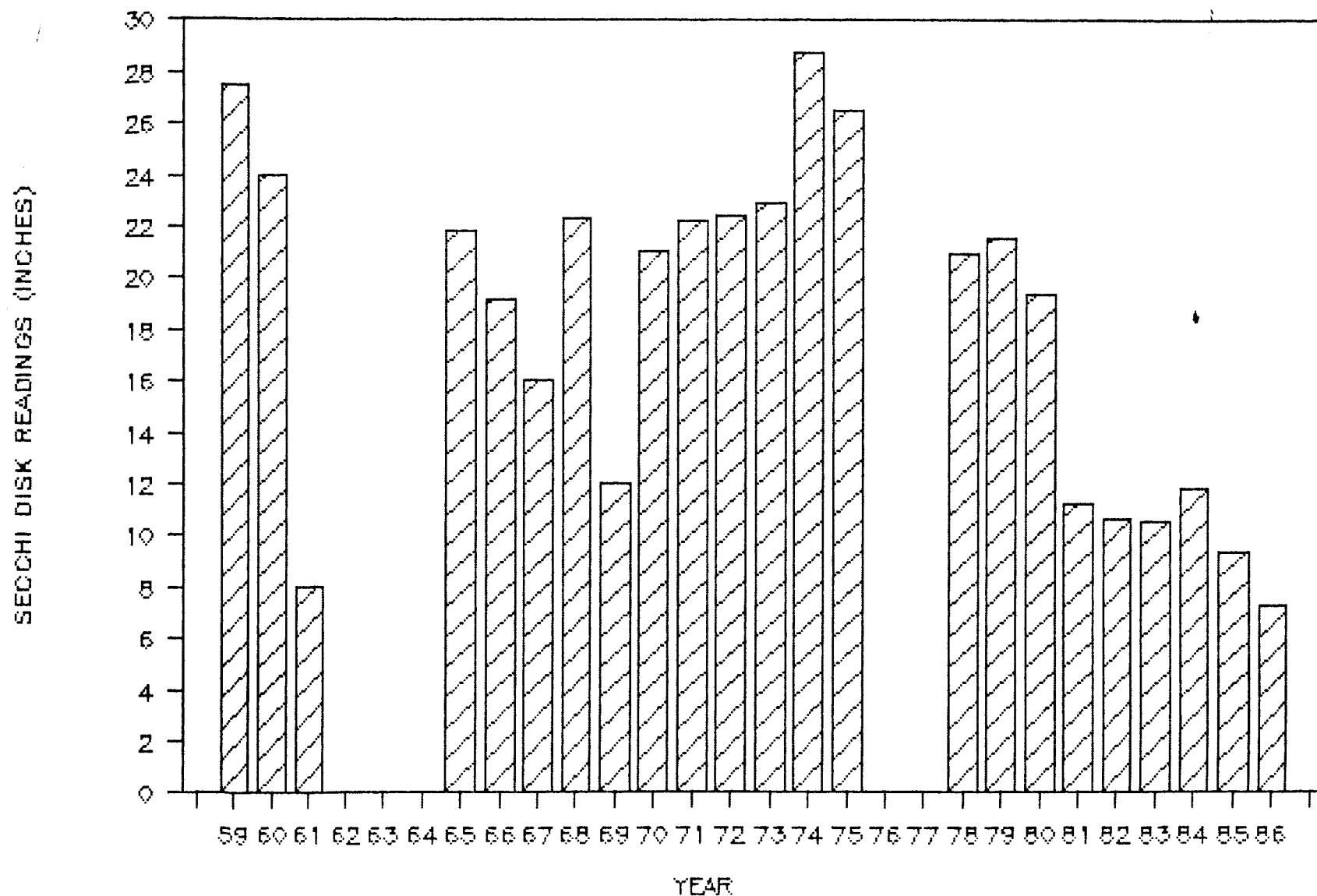


Figure 6. Mean Secchi disc visibility/year (1959-1986) in Back Bay. Number of samples and dates of collection essentially the same as for salinity (Figure 3).

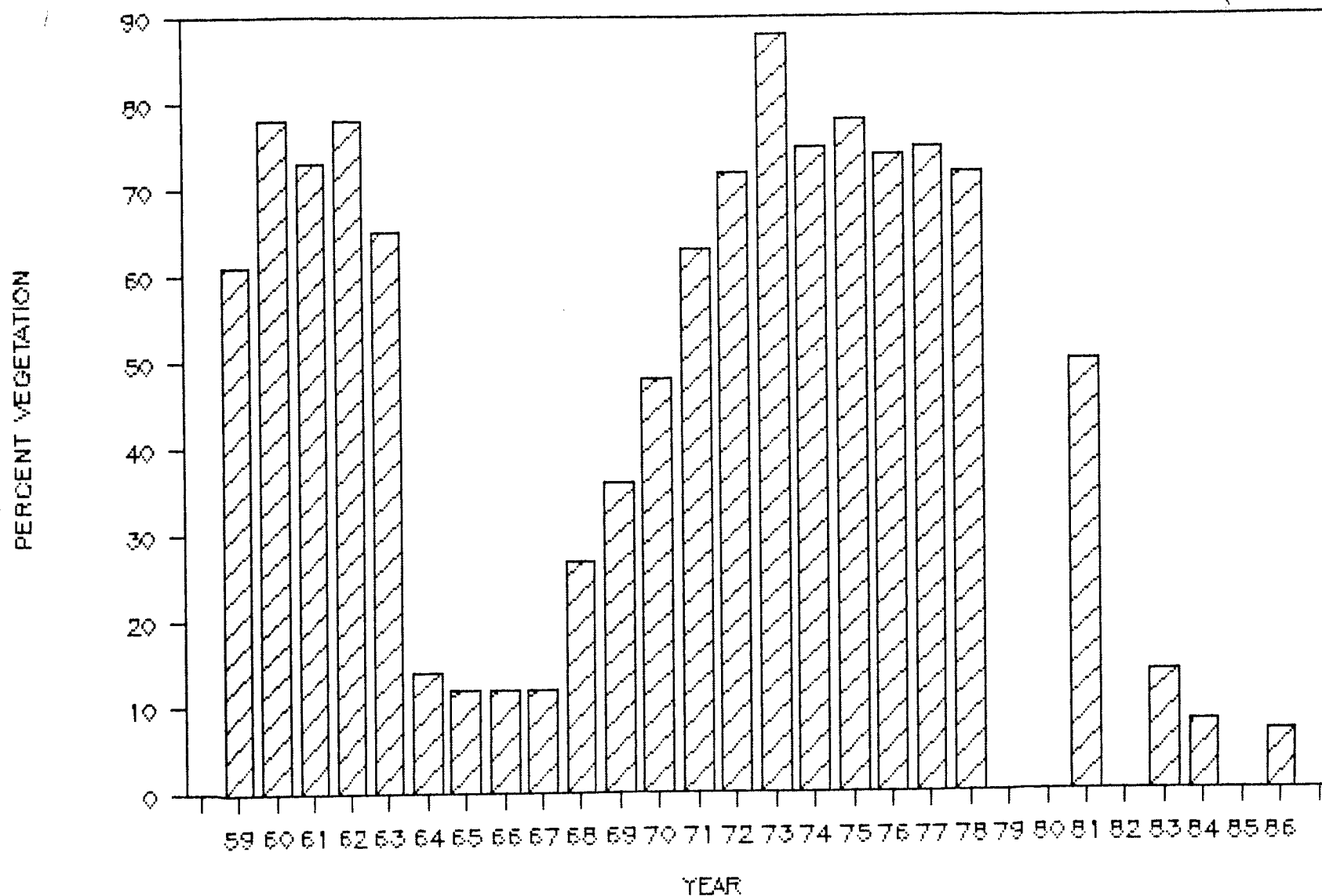


Figure 7. Frequency of vegetation in Back Bay, 1959-1986. Data represent percent of sampling stations with aquatic vegetation. Samples collected every 500 yds. along 8 transects across bay. Sampling generally performed in September of each year (1979, 1980, 1982 and 1985 not

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: January 13, 1986 WATER LEVEL: 9.0 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	3.2°C	3320	3.2	9.1	54	3"	6.9
2	3.2	3320	3.2	9.1	44	4"	6.9
3	3.3	3310	3.2	9.1	52	4"	6.7
4	3.8	3280	3.1	8.9	37	5"	6.7
5	4.0	3120	2.9	8.3	34	5"	6.7
6	4.0	3140	2.9	8.3	35	5"	7.1
7	3.6	3200	3.1	8.9	49	4"	7.2
8	3.4	3080	2.9	8.3	47	3"	7.2
9	3.7	3130	3.0	8.6	32	5"	7.2
10	3.2	3190	3.1	8.9	48	3"	7.3
11	2.9	3100	3.0	8.6	38	4"	7.3
12	3.0	3140	3.0	8.6	47	4"	7.2
13	3.0	3280	3.2	9.1	41	4"	7.2
14	3.2	3280	3.2	9.1	43	4"	7.3
15	4.0	3240	3.0	8.6	33	6"	6.7
16	4.3	3200	3.0	8.6	32	6"	6.6
17	3.5	3340	3.2	9.1	47	4"	6.6
18	3.2	3310	3.2	9.1	42	4"	6.6
19	3.5	3330	3.2	9.1	47	3"	6.6
20	3.9	3340	3.2	9.1	38	3"	6.9
21	3.2	3380	3.2	9.1	41	3"	6.4
22	4.2	3480	3.3	9.4	32	5"	6.4
23							
24							
MEAN	3.6	3250.5	3.1	8.9	41.5	4.1"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: February 19, 1986 WATER LEVEL: 9.7 COLLECTED BY: MDN & RS.

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	9.9°C	3540	2.8	8.0	32	7"	7.2
2	9.8	3680	3.0	8.6	36	6"	7.5
3	8.8	3550	2.9	8.3	25	7"	7.5
4	9.5	3660	2.9	8.3	23	8"	7.5
5	10.1	3680	3.0	8.6	21	8"	7.0
6	9.8	3600	2.9	8.3	24	8"	7.0
7	8.8	3450	2.8	8.0	28	8"	7.5
8	10.3	3390	2.7	7.7	33	7"	7.5
9	9.8	3440	2.8	8.0	31	7"	7.5
10	9.9	3590	2.9	8.3	33	7"	7.5
11	8.9	3500	2.8	8.0	27	8"	7.5
12	9.9	3690	3.0	8.6	21	8"	7.5
13	9.6	3640	2.9	8.3	33	7"	7.0
14	9.3	3380	2.7	7.7	27	7"	7.0
15	10.0	3640	2.9	8.3	21	7"	7.1
16	10.0	3640	2.9	8.3	23	7"	7.0
17	10.5	3760	2.9	8.3	17	9"	7.4
18	10.3	3800	3.0	8.6	17	8"	6.9
19	9.8	3680	2.9	8.3	16	9"	7.0
20	8.4	3520	2.8	8.0	22	7"	6.9
21	9.4	3530	2.9	8.3	18	8"	6.9
22	10.5	3960	3.1	8.6	14	14"	7.1
23	7.5	3520	3.0	8.3	23	7"	7.0
24	11.0	3180	2.4	6.7	20	8"	6.9
MEAN	10.5	3910.0	3.1	8.6	26.6	8.5"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: March 10, 1986 WATER LEVEL: 9.5 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	7.6°C	3400	2.9	8.3	69	3"	6.6
2	6.8	3350	2.8	8.0	91	3"	7.2
3	7.1	3300	2.7	7.7	54	4"	7.4
4	8.2	3390	2.8	8.0	46	5"	7.5
5	7.2	3290	2.8	8.0	56	4"	7.5
6	7.6	3260	2.6	7.4	64	3"	7.6
7	7.0	3270	2.8	8.0	66	3"	7.6
8	7.5	3140	2.6	7.4	58	4"	7.6
9	7.5	3220	2.7	7.7	53	5"	7.6
10	6.8	3230	2.7	7.7	40	4"	7.3
11	6.8	3260	2.8	8.0	57	4"	7.5
12	8.0	3440	2.8	8.0	50	4"	7.6
13	6.6	3320	2.8	8.0	75	3"	7.7
14	7.0	3220	2.7	7.7	55	4"	7.4
15	8.2	3370	2.8	8.0	37	5"	7.6
16	8.7	3390	2.7	7.7	35	5"	7.6
17	7.5	3370	2.8	8.0	57	3"	7.6
18	6.9	3360	2.9	8.3	65	4"	7.6
19	7.3	3380	2.8	8.0	50	4"	7.6
20	6.8	3290	2.8	8.0	47	3"	7.6
21	6.5	3300	2.9	8.3	65	3"	7.3
22	9.6	3720	3.0	8.6	32	6"	7.4
23	6.1	3250	2.8	8.0	47	3"	7.6
24	10.2	2860	2.4	6.9	33	6"	7.5
MEAN	7.5 °C	3307.5	2.8	7.9	54.3	4.0"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: April 28, 1986 WATER LEVEL: 9.9 COLLECTED BY: R.S. & G.W.

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	19.6°C	4720	3.0	8.6	40	7"	7.6
2	17.9	4650	3.1	8.9	28	7"	7.7
3	18.3	4510	2.9	8.3	14	9"	7.5
4	18.2	4680	3.1	8.9	14	9"	7.3
5	18.6	4620	3.0	8.6	14	9"	7.3
6	18.8	4660	3.1	8.9	13	10"	7.2
7	18.8	4610	3.0	8.6	12	7"	7.2
8	18.8	4560	2.9	8.3	14	8"	7.3
9	18.5	4300	2.8	8.0	13	7"	7.6
10	18.5	4610	3.0	8.6	14	7"	7.6
11	18.9	4650	3.0	8.6	14	7"	7.4
12	18.2	4640	3.1	8.9	16	7"	7.4
13	17.3	4650	3.2	9.1	15	7"	7.5
14	19.0	4780	3.1	8.9	16	6"	7.5
15	18.5	4680	3.1	8.9	13	9"	7.7
16	18.8	4720	3.1	8.9	12	9"	7.2
17	17.9	4650	3.1	8.9	12	9"	7.4
18	18.4	4780	3.2	9.1	10	9"	7.2
19	17.5	4580	3.0	8.6	11	10"	7.4
20	18.9	4180	2.8	8.0	8	7"	7.2
21	18.1	4590	3.0	8.6	11	12"	7.0
22	18.9	4850	3.2	9.1	10	10"	7.5
23	18.2	4680	3.2	9.1	14	7"	7.7
24	19.3	4050	2.6	7.4	10	11"	7.3
MEAN	18.4°C	4600	3.0	8.6	14.5	8.3"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: May 14, 1986

WATER LEVEL: 9.0

COLLECTED BY: MDN & GW

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	16.2°C	4640	3.2	9.1	22	9"	7.5
2	15.8	4625	3.2	9.1	21	10"	7.5
3	15.2	4620	3.2	9.1	18	9"	7.3
4	15.8	4580	3.2	9.1	18	9"	7.3
5	15.7	4610	3.2	9.1	16	12"	7.5
6	15.2	4480	3.2	9.1	16	12"	7.5
7	17.0	4580	3.2	9.1	16	11"	7.4
8	16.2	4400	3.1	8.8	23	7	7.7
9	16.2	4440	3.1	8.8	19	9"	7.9
10	16.0	4600	3.2	9.1	26	9"	7.9
11	16.0	4600	3.2	9.1	27	6"	7.3
12	16.2	4610	3.2	9.1	23	9"	7.6
13	16.2	4620	3.2	9.1	19	10"	7.8
14	15.9	4850	3.4	9.7	23	8"	7.9
15	14.8	4580	3.2	9.1	19	9"	7.8
16	14.8	4580	3.2	9.1	16	9"	7.1
17	15.4	4550	3.2	9.1	15	10"	7.4
18	16.0	4780	3.2	9.1	16	9"	7.5
19	15.8	4630	3.3	9.4	18	9"	7.0
20	16.2	4620	3.2	9.1	36	5"	7.3
21	16.0	5100	3.5	10.0	16	10"	7.6
22	15.0	5200	3.7	10.5	11	12"	7.1
23	16.4	5350	3.7	10.5	42	5"	7.6
24	15.6	4610	3.2	9.1	49	5"	7.6
MEAN	15.8	4677.29	3.25	9.26	21.8	8.87	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: June 12, 1986 WATER LEVEL: 10.4 COLLECTED BY: RS & GW

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	26.0°C	6200	3.4	9.7	34	5"	7.8
2	26.0	6200	3.4	9.7	38	4"	8.0
3	26.4	5800	3.0	8.5	23	9"	7.6
4	26.5	6200	3.3	9.4	24	8"	7.7
5	26.0	6400	3.5	10	22	8"	7.8
6	27.0	6200	3.3	9.4	27	8"	8.2
7	26.0	6100	3.2	9.1	17	6"	7.9
8	26.0	6400	3.5	10	27	7"	8.0
9	26.0	6100	3.2	9.1	17	9"	7.7
10	26.0	6200	3.4	9.7	22	8"	7.9
11	26.0	6100	3.3	9.4	20	9"	7.8
12	26.0	6200	3.4	9.7	22	7"	7.7
13	26.0	6200	3.4	9.7	19	9"	7.7
14	26.0	6200	3.4	9.7	27	6"	7.7
15	27.0	6200	3.4	9.7	21	8"	7.7
16	26.0	6300	3.5	10	18	8"	7.7
17	26.2	6200	3.3	9.4	21	8"	7.7
18	26.5	6200	3.4	9.7	16	10"	7.7
19	26.2	6100	3.1	8.8	19	10"	7.7
20	27.0	6100	3.2	9.1	17	9"	7.5
21	27.5	6100	3.2	9.1	15	11"	7.6
22	26.8	6500	3.5	10	14	12"	7.6
23	26.5	6100	3.2	9.1	17	9"	7.6
24	27.0	6200	3.3	9.4	14	11"	7.4
MEAN	26.3°C	6187.0	3.3	9.5	21.3	8.3"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: July 11, 1986

WATER LEVEL: 10.1

COLLECTED BY: MDN & GW

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	27.0°C	6900	3.7	10.6	24	10"	7.5
2	27.0	6800	3.6	10.3	17	13"	7.5
3	27.5	7100	3.8	10.8	5	14"	7.5
4	27.5	7200	3.9	11.1	13	14"	7.4
5	27.0	6600	3.5	10.0	23	10"	7.4
6	27.0	6800	3.6	10.3	7	10"	7.5
7	27.5	6800	3.6	10.3	6	11"	7.6
8	27.4	6800	3.6	10.3	17	14"	7.6
9	27.5	6200	3.3	9.4	14	14"	7.5
10	27.5	6500	3.5	10.0	17	12"	7.5
11	27.5	6800	3.6	10.3	15	12"	7.5
12	27.5	6800	3.6	10.3	18	10"	7.6
13	27.0	7000	3.8	10.8	16	13"	7.5
14	27.5	7200	3.9	11.1	12	17"	7.5
15	27.0	7000	3.8	10.8	5	13"	7.5
16	27.5	7000	3.8	10.8	16	12"	7.5
17	28.0	7200	3.9	11.1	11	14"	7.5
18	27.5	7100	3.8	10.8	9	19"	7.5
19	27.8	7200	3.9	11.1	9	17"	7.5
20	28.0	7000	3.8	10.8	11	17"	7.5
21	28.5	7100	3.8	10.8	4	17"	7.5
22	27.9	7000	3.8	10.8	9	16"	7.5
23	27.5	6900	3.7	10.6	8	19"	7.5
24	28.1	7000	3.8	10.8	10	17"	7.6
MEAN	27.5°C	6916.7	3.7	10.6	12.3	14"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: August 11, 1986 WATER LEVEL: 10.6 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	27.4°C	7000	3.8	10.9	18	4"	7.7
2	26.8	7300	4.1	11.7	17	6"	7.7
3	28.0	7500	3.9	11.1	12	8"	7.7
4	28.5	7600	4.0	11.4	17	6"	7.7
5	28.0	7400	4.0	11.4	13	8"	7.8
6	27.2	7100	3.9	11.1	17	6"	7.8
7	28.2	7100	3.8	10.9	18	5"	7.6
8	28.0	7200	3.8	10.9	15	6"	7.7
9	27.2	7100	3.9	11.1	18	5"	7.7
10	27.8	7200	3.9	11.1	15	6"	7.8
11	27.0	7200	4.0	11.4	15	7"	7.8
12	27.3	7300	3.9	11.1	17	6"	7.6
13	26.0	8100	4.5	12.9	13	8"	7.7
14	28.0	7300	4.0	11.4	12	7"	7.6
15	28.5	7600	4.0	11.4	13	9"	7.7
16	28.0	7500	4.0	11.4	12	9"	7.8
17	28.0	7700	4.0	11.4	12	9"	7.7
18	30.5	7100	3.6	10.3	14	9"	7.7
19	29.0	7200	3.8	10.9	15	8"	7.7
20	27.2	7150	3.8	10.9	12	7"	7.7
21	29.8	7100	3.8	10.9	12	7"	7.7
22	29.8	8800	4.6	13.1	10	13"	7.6
23	27.2	7200	3.9	11.1	10	7"	7.7
24	29.0	7200	3.8	10.9	11	8"	7.6
MEAN	28.0	7372.9	3.95	11.3	15.4	7.3"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: September 12, 1986 WATER LEVEL: 10.4 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	25.4°C	6200	3.5	10.0	30	4"	7.7
2	24.5	6200	3.5	10.0	36	3"	7.7
3	27.5	6400	3.5	10.0	19	8"	7.7
4	25.5	6200	3.5	10.0	17	6"	7.7
5	25.5	6800	3.8	10.9	18	6"	7.6
6	27.8	6600	3.6	10.3	33	4"	8.0
7	24.8	5800	3.1	8.9	30	5"	7.7
8	24.8	6000	3.2	9.1	22	6"	7.7
9	25.0	5100	2.9	8.3	23	5"	7.7
10	24.5	5100	3.0	8.6	18	5"	7.8
11	24.8	5800	3.2	9.1	22	5"	7.7
12	24.8	6200	3.5	10.0	22	5"	7.7
13	24.5	6300	3.5	10.0	22	6"	7.8
14	24.5	6100	3.5	10.0	13	6"	7.6
15	25.2	6800	3.8	10.9	16	6"	7.8
16	25.0	6500	3.7	10.6	13	7"	7.7
17	26.8	9000	4.9	14.0	17	7"	7.8
18	25.5	7000	4.0	11.4	13	7"	7.7
19	26.0	7100	4.1	11.7	14	5"	7.8
20	24.5	6100	3.5	10.0	22	6"	7.7
21	26.0	7100	4.1	11.7	13	9"	7.7
22	26.0	7300	4.2	12.0	12	10"	7.8
23	24.5	6100	3.5	10.0	12	7"	7.8
24	26.0	6500	3.8	10.9	14	7"	7.8
MEAN	25.4°C	6429.2	3.6	10.3	19.6	6"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: October 15, 1986WATER LEVEL: 9.4COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	18.2°C	6700	4.4	12.6	30	4"	7.7
2	18.2	6800	4.4	12.6	43	3"	7.7
3	18.0	6200	4.2	12.0	17	6"	7.8
4	17.8	6800	4.3	12.3	20	5"	7.7
5	17.2	6200	4.2	12.0	33	4"	7.7
6	17.2	5900	4.0	11.4	32	4"	7.7
7	18.0	6200	4.2	12.0	40	3"	7.7
8	17.8	6200	4.2	12.0	26	5"	7.7
9	17.8	5700	3.9	11.1	30	5"	7.6
10	18.2	6200	4.2	12.0	36	3"	7.6
11	18.2	6100	4.1	11.7	39	3"	7.7
12	18.2	6400	4.3	12.3	74	3"	7.6
13	18.2	6800	4.4	12.6	39	3"	7.7
14	18.8	6800	4.4	12.6	27	4"	7.7
15	17.4	6500	4.3	12.3	31	4"	7.7
16	17.0	6300	4.2	12.0	47	5"	7.6
17	18.2	6900	4.5	12.9	22	6"	7.7
18	18.2	6900	4.5	12.9	21	6"	7.7
19	18.2	6600	4.4	12.6	17	6"	7.6
20	18.2	6100	4.0	11.4	17	4"	7.7
21	18.0	6800	4.4	12.6	30	5"	7.6
22	18.0	6900	4.5	12.9	12	8"	7.8
23	18.5	6500	4.2	12.0	30	4"	7.7
24	18.0	6400	4.3	12.3	23	4"	7.6
MEAN	18.0	6454.2	4.3	12.2	30.7	4.5"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: November 10, 1986 WATER LEVEL: 9.8 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY (PPT) (%SS)		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
1	16.2°C	5800	4.0	11.4	22	5"	7.6
2	16.2	6200	4.4	12.6	46	4"	7.5
3	16.2	6200	4.3	12.3	21	7"	7.6
4	16.2	6200	4.3	12.3	36	4"	7.7
5	15.5	6000	4.2	12.0	28	6"	7.6
6	15.5	6000	4.2	12.0	36	4"	7.7
7	16.4	6000	4.2	12.0	27	6"	7.6
8	16.4	6000	4.2	12.0	27	5"	7.5
9	16.8	6000	4.2	12.0	34	4"	7.5
10	16.8	5700	4.1	11.7	37	4"	7.6
11	16.8	5600	4.0	11.4	37	3"	7.6
12	16.2	6100	4.2	12.0	39	3"	7.5
13	16.5	6300	4.5	12.9	18	6"	7.6
14	17.0	6200	4.4	12.6	27	6"	7.7
15	15.5	6000	4.2	12.0	37	4"	7.7
16	15.5	6000	4.2	12.0	20	6"	7.6
17	16.8	6300	4.4	12.6	15	7"	7.6
18	17.2	7000	4.9	14.0	12	12"	7.6
19	16.5	6300	4.3	12.3	22	5"	7.6
20	17.8	6300	4.3	12.3	28	4"	7.6
21	16.3	6400	4.4	12.6	28	4"	7.6
22	17.2	7000	4.9	14.0	16	11"	7.5
23	16.4	6200	4.5	12.9	17	5"	7.5
24	18.0	6300	4.3	12.3	24	4"	7.5
MEAN	16.5	6170.8	4.3	12.3	27.3	5.4"	

VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY WATER CHEMISTRY

DATE: December 8, 1986 WATER LEVEL: 9.3 COLLECTED BY: MDN & RS

STATION NO.	WATER TEMP. (°C)	SPECIFIC CONDUCTANCE (MICROMHS/CM)	SALINITY		TURBIDITY (NTU)	SECCHI DISK VISIBILITY (INCHES)	pH
			(PPT)	(%SS)			
1	7.8°C	4800	4.0	11.4	18	9"	7.4
2	7.8	4900	4.1	11.7	19	8"	7.5
3	8.8	5000	4.2	12.0	19	7"	7.5
4	7.9	4800	4.0	11.4	16	8"	7.5
5	8.0	4500	3.8	10.9	16	8"	7.5
6	8.2	4800	4.0	11.4	18	8"	7.5
7	8.2	4800	4.0	11.4	19	8"	7.5
8	8.1	4700	3.9	11.1	17	8"	7.5
9	8.0	4600	3.9	11.1	18	9"	7.5
10	7.8	4800	4.0	11.4	17	8"	7.5
11	8.0	4800	4.0	11.4	19	7"	7.5
12	7.8	4500	3.9	11.1	17	9"	7.5
13	7.8	4900	4.1	11.7	16	8"	7.5
14	7.8	4800	4.0	11.4	18	7"	7.5
15	8.3	4800	3.9	11.1	16	10"	7.5
16	8.2	4200	3.8	10.9	15	10"	7.5
17	8.2	4900	4.1	11.7	16	8"	7.5
18	8.5	5000	4.2	12.0	13	9"	7.5
19	8.5	5000	4.2	12.0	17	9"	7.5
20	8.8	5000	4.3	12.3	14	8"	7.5
21	8.5	5000	4.2	12.0	15	9"	7.5
22	8.2	5300	4.5	12.9	10	12"	7.5
23	8.0	4900	4.1	11.7	18	8"	7.5
24	8.9	5200	4.4	12.6	12	8"	7.5
MEAN	8.2	4833.3	4.1	11.6	16.4	8.6"	

Table 2. Collective results of trawl/seine sampling in Back Bay, Sept., 1985 - Dec., 1986.

	<u>Total</u>	<u>%</u>
<u>FRESHWATER</u>		
Bowfin	14	0.04
Chain pickerel	10	0.03
Golden shiner	5	0.01
White catfish	65	0.18
Channel catfish	48	0.14
Yellow bullhead	7	0.02
Brown bullhead	10	0.03
Bluespotted sunfish	9	0.03
Bluegill	13	0.04
Largemouth bass	17	0.05
Black crappie	311	0.88
Yellow perch	35	0.10
Subtotal	544	1.55
<u>FRESH/BRACKISH</u>		
Longnose gar	46	0.13
American eel	77	0.22
Gizzard shad	656	1.87
Carp	236	0.67
Banded killifish	118	0.34
Mosquitofish	65	0.18
Tidewater silversides	4639	13.20
White perch	7286	20.74
Pumpkinseed	183	0.52
Subtotal	13,306	37.87
<u>BRACKISH/MARINE</u>		
Ladyfish	2	tr
Blueback herring	69	0.20
Atlantic menhaden	4790	13.63
Alewife	8	0.02
Bay anchovy	7883	22.44
Atlantic needlefish	2	tr
Sheepshead minnow	282	0.80
Mummichog	6	0.02
Threespine stickleback	1	tr
Pipefish	10	0.03
Spot	7661	21.81
Atlantic croaker	452	1.29
Silver perch	60	0.17
Striped mullet	39	0.11
Naked goby	8	0.02
Winter flounder	2	tr
Hogchoker	6	0.02
Blackcheek toungefish	1	tr
Subtotal	21,282	60.58
TOTAL	35,132	

Table 3 . Number and relative abundance of fishes collected in shoreline seine sampling (50 ft. minnow seine) in Back Bay, 1985-86 (number of seine samples/date: 29 on 9/85; 11 on 8/86; 13 on 9/86).

	No. Fish				
	<u>Sept/85</u>	<u>Aug/86</u>	<u>Sept/86</u>	<u>Total</u>	<u>%</u>
<u>FRESHWATER</u>					
Water catfish	-	2	-	2	tr
Bluespotted sunfish	7	-	2	9	0.1
Bluegill	-	-	1	1	tr
Largemouth bass	1	1	-	2	tr
Yellow perch	2	-	1	3	tr
Subtotal	10	3	4	17	0.2
<u>FRESH/BRACKISH</u>					
American eel	3	3	3	9	0.1
Gizzard shad	-	8	24	32	0.4
Carp	-	3	2	5	tr
Banded killifish	82	20	16	118	1.4
Mosquitofish	62	-	3	65	0.8
Tidewater silversides	3161	839	621	4621	55.4
White perch	63	65	19	147	1.8
Pumpkinseed	26	3	2	31	9.4
Subtotal	3397	941	690	5028	60.3
<u>BRACKISH/MARINE</u>					
Ladyfish	-	2	-	2	tr
Blueback herring	30	6	-	36	0.4
Atlantic menhaden	139	11	1	151	1.8
Bay anchovy	551	1204	483	2238	26.8
Atlantic needlefish	1	1	-	2	tr
Sheepshead minnow	67	3	212	282	3.4
Mummichog	3	2	1	6	tr
Pipefish	-	3	4	7	tr
Spot	57	359	112	528	6.3
Atlantic croaker	-	3	-	3	tr
Silver perch	3	2	-	5	tr
Striped mullet	15	3	12	30	0.4
Naked goby	6	-	2	8	0.1
Hogchoker	1	-	-	1	tr
Blackcheek toungefish	1	-	-	1	tr
Subtotal	874	1599	827	3300	39.5
TOTAL	4281	2543	1521	8345	

Table 4 . Number and relative abundance of fishes collected in haul seine sampling (10 tows of seine 250 yds. lt., 8 ft. ht., 115 in. bar mesh) in Back Bay, November 26-27, 1985.

	<u>No. Fish</u>	<u>%</u>
<u>Freshwater</u>		
Bowfin	2	tr
Chain pickerel	9	0.4
White catfish	31	1.3
Channel catfish	29	1.2
Bluegill	2	tr
Largemouth bass	8	0.3
Black crappie	118	5.1
Subtotal	199	8.6
<u>FRESH/BRACKISH</u>		
Longnose gar	2	tr
American eel	1	tr
Gizzard shad	361	15.5
Carp	45	1.9
White perch	1696	73.1
Pumpkinseed	3	tr
Subtotal	2108	90.8
<u>BRACKISH/MARINE</u>		
Atlantic menhaden	5	0.2
Pipefish	3	0.1
Atlantic croaker	3	0.1
Striped mullet	3	0.1
Subtotal	14	0.6
TOTAL	2321	

Table 5. Number and relative abundance of fishes collected in trawl sampling in Back Bay, Oct., 1985 through Dec., 1986. Number in parenthesis below date is number of twenty-minute tows/date.

	Oct/85 (30)	Nov/85 (22)	Mar/86 (18)	April/86 (4)	May/86 (21)	June/86 (21)	Aug/86 (15)	Sept/86 (14)	Oct/86 (11)	Dec/86 (12)	Total	%
<u>FRESHWATER</u>												
Bowfin	-	3	-	-	1	-	-	3	2	3	12	0.05
Chain pickerel	-	1	-	-	-	-	-	-	-	-	1	tr
Golden shiner	1	4	-	-	-	-	-	-	-	-	5	0.02
White catfish	8	5	3	2	4	5	-	2	1	2	32	0.13
Channel catfish	4	-	6	1	2	-	1	1	3	1	19	0.08
Yellow bullhead	-	2	3	-	-	-	-	-	-	2	7	0.03
Brown bullhead	-	1	2	-	-	-	-	-	2	5	10	0.04
Bluegill	-	-	4	-	-	3	-	3	-	-	10	0.04
Largemouth bass	-	-	1	4	-	-	-	1	-	1	7	0.03
Black crappie	23	43	53	19	5	1	-	20	17	12	193	0.79
Yellow perch	4	4	14	4	2	-	-	2	-	2	32	0.13
Subtotal	40	63	86	30	14	9	1	32	25	28	328	1.34
<u>FRESH/BRACKISH</u>												
Longnose gar	-	-	23	-	-	5	2	3	-	11	44	0.18
American eel	3	3	21	-	15	5	-	11	5	4	67	0.27
Gizzard shad	14	43	63	2	12	18	3	13	44	51	263	1.07
Carp	20	22	29	8	25	20	24	11	12	15	186	0.76
Tidewater silversides	1	12	1	1	-	2	1	-	-	-	18	0.07
White perch	612	908	980	12	513	304	358	443	654	659	5443	22.25
Pumpkinseed	7	73	10	19	1	1	1	3	-	34	149	0.61
Subtotal	657	1061	1127	42	566	355	389	484	715	774	6170	25.22
<u>BRACKISH/MARINE</u>												
Blueback herring	2	2	-	10	-	-	17	1	1	-	33	0.13
Atlantic menhaden	36	10	-	7	116	3607	554	127	175	2	4634	18.94
Alewife	4	-	2	1	-	-	-	1	-	-	8	0.03
Bay anchovy	2284	346	-	41	80	605	1393	685	185	26	5645	23.07
Threespine stickleback	-	-	1	-	-	-	-	-	-	-	1	tr
Spot	352	57	6	788	1882	1697	465	989	896	1	7133	29.15
Atlantic croaker	-	1	-	-	-	160	198	81	6	-	446	1.82
Silver perch	18	-	-	-	-	5	4	19	9	-	55	0.22
Striped mullet	1	5	-	-	-	-	-	-	-	-	6	0.02
Winter flounder	-	-	1	-	1	-	-	-	-	-	2	tr
Hogchoker	-	-	-	-	2	1	-	-	2	-	5	0.02
Subtotal	2697	421	10	847	2081	6075	2631	1903	1274	29	17968	73.44
TOTAL	3394	1545	1223	919	2661	6439	3021	2419	2014	831	24466	

Table 6. CPUE for fishes collected in trawl sampling in Back Bay, Oct., 1985 through Dec., 1986. Number in parenthesis below date is number of twenty-minute tows/date.

	Oct/85 (30)	Nov/85 (22)	Mar/85 (18)	April/86 (4)	May/86 (21)	June/86 (21)	Aug/86 (15)	Sept/86 (14)	Oct/86 (11)	Dec/86 (12)	Total
<u>FRESHWATER</u>											
Bowfin	-	0.14	-	-	0.05	-	-	0.21	0.18	0.25	0.07
Chain pickerel	-	0.04	-	-	-	-	-	-	-	-	0.01
Golden shiner	-	0.04	0.22	-	-	-	-	-	-	-	0.03
White catfish	0.27	0.23	0.17	0.50	0.19	0.24	-	0.14	0.09	0.17	0.19
Channel catfish	0.13	-	0.33	0.25	0.09	-	0.07	0.07	0.27	0.08	0.11
Yellow bullhead	-	0.09	0.17	-	-	-	-	-	-	0.17	0.04
Brown bullhead	-	0.04	0.11	-	-	-	-	-	0.18	0.42	0.06
Bluegill	-	-	0.22	-	-	0.14	-	0.21	-	-	0.06
Largemouth bass	-	-	0.05	1.00	-	-	-	0.07	-	0.08	0.04
Black crappie	0.77	1.95	2.94	4.75	0.24	0.05	-	1.43	1.54	1.00	1.15
Yellow perch	0.13	0.18	0.78	1.00	0.09	-	-	0.14	-	0.17	0.19
Subtotal	1.30	2.71	4.99	7.50	0.66	0.43	0.07	2.27	2.26	2.34	1.95
<u>FRESH/BRACKISH</u>											
Longnose gar	-	-	1.28	-	-	0.24	0.13	0.21	-	0.92	0.26
American eel	0.10	0.14	1.17	-	0.71	0.24	-	0.78	0.45	0.33	0.40
Gizzard shad	0.47	1.95	3.50	0.50	0.57	0.86	0.20	0.93	4.00	4.25	1.56
Carp	0.67	1.00	1.61	2.00	1.19	0.95	1.60	0.79	1.09	1.25	1.11
Tidewater silversides	0.03	0.54	0.05	0.25	-	0.09	0.07	-	-	-	0.11
White perch	20.40	41.27	54.44	3.00	24.42	14.48	23.87	31.64	59.45	54.92	32.40
Pumpkinseed	0.23	3.32	0.55	4.75	0.05	0.05	0.07	0.21	-	2.83	0.89
Subtotal	21.90	48.22	62.60	10.50	26.94	16.91	25.94	34.56	64.99	64.50	36.73
<u>BRACKISH/MARINE</u>											
Blueback herring	0.07	0.09	-	0.40	-	-	1.13	0.07	0.09	-	5.09
Atlantic menhaden	1.20	0.45	0.39	-	5.52	171.76	36.93	9.07	15.91	0.17	27.58
Alewife	0.13	-	0.11	0.25	-	-	-	0.07	-	-	0.05
Bay anchovy	76.13	15.73	-	10.25	3.80	28.81	92.87	48.93	16.82	2.17	33.60
Three-spine stickleback	-	-	0.05	-	-	-	-	-	-	-	0.01
Spot	11.73	2.59	0.33	197.00	89.62	80.81	31.00	70.64	81.45	0.08	42.46
Atlantic croaker	-	0.04	-	-	-	7.62	13.20	5.79	0.54	-	2.65
Silver perch	0.60	-	-	-	-	0.24	0.27	1.36	0.82	-	0.33
Striped mullet	0.03	0.23	-	-	-	-	-	-	-	-	0.04
Winter flounder	-	-	0.05	-	0.05	-	-	-	-	-	0.01
Hogchoker	-	-	-	-	0.09	0.05	-	-	0.18	-	0.03
Subtotal	89.89	19.13	0.93	207.90	99.08	289.29	175.40	135.93	115.81	2.42	111.85
TOTAL	113.09	70.06	68.52	225.90	126.68	306.63	201.41	172.76	183.06	69.26	150.53

Table 7 . Standing crop (lbs/ac) and relative abundance of Back Bay fishes collected in cove rotenone samples (2 coves totaling 3.44 acres), July, 1986.

	<u>lb/ac</u>	<u>% Total</u>
<u>FRESHWATER</u>		
Chain pickerel	0.01	0.01
Golden shiner	0.15	0.13
Yellow bullhead	0.25	0.22
Brown bullhead	0.07	0.06
Bluespotted sunfish	0.64	0.55
Bluegill	0.84	0.73
Largemouth bass	2.47	2.14
Black crappie	0.05	0.04
Yellow perch	0.29	0.25
Subtotal	4.77	4.13
<u>FRESH/BRACKISH</u>		
Longnose gar	8.59	7.45
Gizzard shad	0.18	0.16
Carp	8.70	7.55
Banded killifish	5.85	5.08
Mosquitofish	0.26	0.22
Tidewater silversides	1.48	1.28
White perch	29.60	25.69
Pumpkinseed	5.32	4.62
Subtotal	59.98	52.05
<u>BRACKISH/MARINE</u>		
Ladyfish	0.20	0.17
Atlantic menhaden	0.76	0.66
Bay anchovy	0.15	0.13
Atlantic needlefish	0.31	0.27
Sheepshead minnow	8.22	7.13
Mummichog	0.09	0.08
Spot	20.22	17.55
Striped mullet	19.68	17.08
Winter flounder	0.85	0.74
Subtotal	50.48	43.81
TOTAL	115.23	100.

Table 8. Comparison of standing crop data for Back Bay fishes in 1978 and 1986. Figures represent lbs/ac from cove rotenone samples (2 coves totaling 3.44 ac).

	<u>1978</u>	<u>1986</u>	<u>% Change</u>
<u>FRESHWATER</u>			
Bowfin	0.46	-	100 % dec.
Eastern mudminnow	0.03	-	100 % dec.
Chain pickerel	-	0.01	100 % inc.
Golden shiner	0.45	0.15	67 % dec.
Yellow bullhead	-	0.25	inc.
Brown bullhead	2.36	0.07	97 % dec.
Bluespotted sunfish	0.94	0.64	32 % dec.
Bluegill	1.50	0.84	44 % dec.
Largemouth bass	19.43	2.47	87 % dec.
Black crappie	1.30	0.05	96 % dec.
Subtotal	26.47	4.48	83 % dec.
<u>FRESH/BRACKISH</u>			
Longnose gar	17.23	8.59	50 % dec.
American eel	1.00	-	100 % dec.
Gizzard shad	0.25	0.18	28 % dec.
Carp	1.61	8.70	440 % inc.
Banded killifish	0.03	5.85	19400 % inc.
Mosquitofish	0.01	0.26	2500 % inc.
Tidewater silversides	0.29	1.48	410 % inc.
White perch	8.16	29.60	263 inc.
Pumpkinseed	39.62	5.32	87 % dec.
Yellow perch	6.89	0.29	96 % dec.
Subtotal	75.09	60.27	20 % dec.
<u>BRACKISH/MARINE</u>			
Ladyfish	-	0.20	inc.
Atlantic menhaden	2.77	0.76	73 % dec.
Bay anchovy	-	0.15	inc.
Atlantic needlefish	0.20	0.31	55 % inc.
Sheepshead minnow	-	8.22	inc.
Mummichog	-	0.09	inc.
Spot	26.76	20.22	24 % dec.
Striped mullet	4.69	19.68	320 % inc.
Winter flounder	-	0.85	inc.
Subtotal	34.42	50.48	47 % inc.
TOTAL	135.98	115.23	15 % dec.

Table 9. Comparison of reproductive success of Back Bay fishes in 1978 and 1986. Figures represent No. YOY fish/acre from cove rotenone samples (2 coves totaling 3.44 acres). Salinity range in Back Bay during spawning season (Apr-July): 2.4-2.6‰ SS, 1978; 8.6-10.6‰ SS, 1986.

	<u>1978</u>	<u>1986</u>	<u>% Change</u>
<u>FRESHWATER</u>			
Bowfin	3.69	-	100% dec.
Chain pickerel	-	0.29	inc.
Golden shiner	9.71	3.20	67% dec.
Yellow bullhead	-	14.24	inc.
Brown bullhead	143.01	22.67	84% dec.
Bluegill	16.07	-	100% dec.
Largemouth bass	134.00	22.67	83% dec.
Black crappie	38.24	2.03	95% dec.
Subtotal	344.72	65.1	81% dec.
<u>FRESH/BRACKISH</u>			
Longnose gar	1.72	1.74	1% inc.
Carp	167.69	1104.93	559% inc.
Tidewater silversides	131.48	359.30	173% inc.
White perch	794.91	15.70	98% dec.
Pumpkinseed	302.35	100.29	67% dec.
Yellow perch	13.59	1.45	89% dec.
Subtotal	1411.74	1583.41	12% inc.
<u>BRACKISH/MARINE</u>			
Atlantic menhaden	54.34	189.82	249% inc.
Bay anchovy	-	30.24	inc.
Atlantic needlefish	5.70	35.75	527 % inc.
Sheepshead minnow	-	3684.01	inc.
Mummichog	-	13.66	inc.
Spot	6.46	2163.95	33,398 % inc.
Striped mullet	21.50	752.91	3,402 % inc.
Subtotal	88.00	6870.34	7,707 % inc.
TOTAL	1,844.66	8,518.85	